Citation:

Sebastian RS, Cleveland LE, Goldman JD. Effect of snacking frequency on adolescents' dietary intakes and meeting national recommendations. *J Adolesc Health*. 2008 May; 42 (5): 503-11. Epub 2008 Feb 7.

PubMed ID: 18407046

Study Design:

Cross-Sectional Study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To determine the impact of the level of snacking on:

- Intake of nutrients and food groups, and
- How this assists in meeting recommendations outlined in the USDA's *My Pyramid* Food Guidance System.

Inclusion Criteria:

Adolescents aged 12-19 years participating in "What We Eat in America," the dietary interview component of the NHANES 2001-2004 survey.

Exclusion Criteria:

Pregnant adolescent girls.

Description of Study Protocol:

Recruitment

- The study sample is from What We Eat in America, the dietary interview component of the National Health and Nutrition Examination Survey (WWEIA- NHANES) that was conducted in 2001-2004 by USDA and the US Department of Health and Human Services. The NHANES was designed to yield a sample representative of the non-institutionalized population of the United States. As a focal area of the most recent NHANES is adolescent health, persons 12-19 years of age were oversampled to produce reliable estimates [13,14].
- A total of 4,459 adolescents aged 12-19 years provided complete and reliable dietary intake data. Pregnant, adolescent girls (N=102) were excluded from this analysis, yielding a final

sample of 4,357 adolescents (2,244 male and 2,113 female).

Design

- Survey
- Dietary data based on 24-hour recall from 4357 adolescents 12-19 years of age participating in the NHANES Survey 2001-2004 were analyzed.

Dietary Intake/Dietary Assessment Methodology

Calculation of nutrient intake

- The source of the nutrient values was the Food and Nutrient Database for Dietary Studies (FNDDS)
- Nutrient values in FNDDS were derived using the most current food composition data from the USDA National Nutrient Database for Standard Reference that was available at the time of survey data collection Nutrient in-takes for individuals were calculated by using the gram amounts of food consumed and the nutrient values for the food as listed in the FNDDS expressed per 100 g of food.
- Contributions made by supplemental vitamin or minerals were not included in nutrient calculations
- The *MyPyramid* Food Guidance System defines 12 dietary patterns at energy levels ranging from 1,000-3,200 kilocalories, from which the appropriate pattern for an individual can be selected. Each dietary pattern specifies recommended amounts (cup or ounce equivalents) to eat from five basic food groups (grains, fruits, vegetables, milk and meat or beans) and oils. Limits are also set on discretionary calories from solid fats (which are usually high in saturated fats and/or trans fats and found in butter, margarine, full-fat animal products, and many processed foods), added sugars and alcohol.

Blinding Used

Not applicable.

Intervention

Not applicable.

Statistical Analysis

- Linear regression was used to provide estimates of mean intake of each nutrient and food group at different snacking levels (no snacks, one snack, two snacks, three snacks and four or more snacks)
- Logistic regression was used to generate estimates of the percentage of adolescents meeting *MyPyramid* recommendations by snacking level and to test for a relationship between snacking frequency and the likelihood of meeting *MyPyramid* recommendations
- Separate logistic regression analysis were conducted to identify which sub-groups of adolescents were most at risk for not meeting their *MyPyramid* recommendations based on snacking category.

Data Collection Summary:

Timing of Measurements

2001-2004.

Dependent Variables

- Intake of nutrients and food groups
- Ability to meet recommendations outlined in the USDA's *MyPyramid* Food Guidance System.

Independent Variables

The level of snacking.

Control Variables

None.

Description of Actual Data Sample:

- *Initial N:* 4,459
- *Attrition (final N):* 4,357
  - 2,244 males
  - 2,113 females
- *Age:* 12-19 years
- *Ethnicity:* None stated
- *Other relevant demographics:* None stated
- *Anthropometrics:* None stated
- *Location:* US.

Summary of Results:

Mean Intake of *MyPyramid* Food Groups and Percentage Meeting Recommendations by Snacking Level Among Adolescents 12-19 Years of Age, 2001-2004

Gender Group and *MyPyramid* Component	0 Snacks	1 Snack	2 Snacks	3 Snacks	4+ Snacks	Value (T-test)	
	Number of Portions (Percent Meeting Recommendations)					Portions	Percent Meeting Recommendations
Boys							
Grains (ounce equivalents)	9.1 (53)	9.4 (58)	8.8 (52)	8.4 (58)	8.8 (59)	0.101	0.286
Vegetables (cups)	1.5 (8)	1.4 (8)	1.4 (8)	1.4 (8)	1.3 (5)	0.79	0.90
Fruit (cups)	0.7 (15)	0.8 (14)	0.9 (14)	0.9 (13)	1.7 (28)	<0.001	0.003

Milk (cups)	2.6 (27)	2.4(26)	2.5 (25)	2.6 (38)	2.5 (44)	0.876	<0.001
Meat/beans (ounce equivalents)	6.9 (51)	6.1 (44)	6.4 (47)	6.0 (38)	5.3 (40)	0.013	0.039
Oils (teaspoon)	3.4 (7)	4.3 (14)	4.6 (20)	4.9 (18)	4.7 (18)	0.017	0.006
Solid fats (grams)	66.0	61.5	59.4	55.7	54.9	<0.001	
Discretionary calories	1,110 (2)	1,112 (2)	1,105 (1)	1,122 (2)	1,104 (1)	0.928	0.557
Added sugars (teaspoons)	30.1	32.2	33.1	36.2	35.7	0.016	
Girls							
Grains (ounce equivalents)	7.1 (61)	6.8 (48)	6.9 (52)	6.7 (49)	6.4 (44)	0.048	0.028
Vegetables (cups)	1.2 (13)	1.2 (6)	1.2 (8)	1.1 (6)	1.1 (6)	0.177	0.377
Fruit (cups)	0.6 (11)	0.8 (19)	0.8 (14)	1.0 (22)	1.3 (27)	<0.177	<0.001
Milk (cups)	1.8 (12)	1.8(19)	1.8 (17)	1.7 (20)	1.7 (19)	<0.001	0.107
Meat/beans (ounce equivalents)	4.5 (37)	4.4(34)	4.3 (30)	4.0 (20)	3.8 (25)	0.578	0.025
Oils (teaspoon)	3.1 (19)	3.4 (21)	4.0 (20)	3.9 (18)	5.3 (27)	0.011	0.226
Solid fats (grams)	45.2	45.5	43.6	44.6	40.2	0.961	
Discretionary calories	772 (5)	802 (3)	796 (1)	829 (1)	826 (>0.5)	0.076	0.002
Added sugars (teaspoons)	22.3	23.6	24.5	25.9	27.6	<0.001	

Author Conclusion:

- Frequency of snacking affects intake of both macronutrients and micronutrients. It promotes

consumption of fruits.

- Top snack choices provide an excess of discretionary calories in the form of added sugars and fats
- Modification of adolescents' food choices would help them to consume diets that are more consistent with national recommendations.

Reviewer Comments:

None.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes

2.4.		Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**		Yes
3.1.		Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.		Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.		Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.		If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.		If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	Yes
3.6.		If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**		Yes
4.1.		Were follow-up methods described and the same for all groups?	N/A
4.2.		Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.		Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.		Were reasons for withdrawals similar across groups?	N/A
4.5.		If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**		Yes
5.1.		In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.		Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.		In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes

5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?		N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?		N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**		Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?		N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?		Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?		N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?		N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?		N/A
6.6.	Were extra or unplanned treatments described?		N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?		N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?		N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**		Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?		N/A
7.2.	Were nutrition measures appropriate to question and outcomes of concern?		Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?		N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?		Yes
7.5.	Was the measurement of effect at an appropriate level of precision?		Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?		Yes
7.7.	Were the measurements conducted consistently across groups?		Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?		Yes

8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes